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ABSTRACT

This study assesses research findings and practical field experiences emerging from electronic text trials and services with emphasis on applications of electronic text that have served the needs of higher education. However, research findings and case studies from commercial applications, as well as secondary and K-8 electronic text projects, are included to provide a broad context for understanding how electronic text is developing. The report focuses on experiences in the United States, particularly those of public broadcasting stations. For comparative purposes, applications in Britain and Canada are reviewed, as well as selected research findings and policy issues that have emerged from trials in France and Sweden. Following an overview of the report in section 1, section 2 provides a glossary of terms to be used and reviews some of the strengths and weaknesses associated with alternative means of transmitting electronic text. Section 3 reviews educational applications in Britain, Canada, and the United States. Research findings are analyzed, the costs of low and high end systems are outlined, and page design and organizational issues are discussed. Section 4 reviews selected commercial applications in Europe and the United States. Section 5 outlines the educational context in which electronic text must develop, including current patterns of use for telecommunications and organizational barriers. The report concludes with a discussion of gaps in knowledge and general options for higher education institutions and those who provide services for the education community. A selected bibliography is included. (THC)

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Electronic Text Consortium

Electronic Text for Higher Education

San Diego State University, University of Wisconsin, University of Nebraska, WGBH Boston

ED257446

ELECTRONIC TEXT
AND HIGHER EDUCATION:
A SUMMARY OF RESEARCH FINDINGS
AND FIELD EXPERIENCES

Report Number One
of the
Electronic Text Report Series

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The Annenberg/CPB Project

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Report Number One
of the
Electronic Text Report Series

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An Annenberg/CPB Project

The mandate of The Annenberg/CPB Project over a 15-year period is to create innovative, quality college-level materials and to demonstrate unique applications of telecommunications technologies in higher education problems.

1984

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1. PREFACE

The purpose of this study is to provide an assessment of research findings and practical field experiences emerging from electronic text trials and services. An emphasis is placed upon applications of electronic text to date that have served the needs of higher education. However, research findings and case study materials from commercial applications as well as secondary and K-8 electronic text projects are also included in order to provide a broad context for understanding how electronic text is developing. In addition, the report focuses upon U.S. experiences to date, particularly those of public broadcasting stations. For comparative purposes, applications in Britain and Canada are reviewed as well as selected research findings and policy issues that have emerged from trials in France and Sweden.

The report is organized in a straightforward manner. Section 2 provides a glossary of terms to be used and reviews some of the strengths and weaknesses associated with alternative means of transmitting electronic text. Section 3 reviews educational applications of electronic text in Britain, Canada and the U.S. Research findings are analyzed and the costs of low and high end systems are outlined. In addition, page design and organizational issues are discussed. Section 4 reviews selected commercial applications in Europe and the U.S. A secondary analysis of commercial research data is undertaken in order to

draw inferences for higher education. Further, the general market context is reviewed with an emphasis upon the personal computer and its entry into homes and schools. Section 5 outlines the educational context in which electronic text must develop. This includes the current patterns of use for telecommunications, as well as organizational barriers. These are used in an assessment of opportunities and options for the development of electronic text services in higher education. Section 6 concludes with a discussion of gaps in knowledge and general options for higher education institutions and those who provide services for the education community (e.g. publishers and educational broadcasters).

This report was prepared in coordination with and input by many individuals. John Witherspoon served as Project Director and guided the work throughout. Other consortium members who contributed to the project included Ronald Bornstein, Christopher Hassett, George Stein and Steven Vedro. Additional input was provided by Shelley Isaacson (WGBH), Jack McBride (KUON), Carole Osterer (WGBH), and Lee Rockwell (KUON). The report draws upon the published works of a large community of researchers. Their work is listed in a Selected Bibliography at the end of the report.

2. INTRODUCTION

The first problem in trying to come to grips with electronic text is to agree about the terms for this multi-headed creature. There is a great deal of inconsistency in the words used to describe alternative forms of electronic text. Only the passage of time can resolve the problem: certain terms will gain general acceptance and others will fall into disuse. In this report, terms will be used in the following manner:

Electronic Text	A generic term for all forms of text and graphical information that are digitally encoded and transmitted via broadcast signal, cable, and telephone wire; or, made available on a diskette/ cassette.
Teletext	One-way electronic text that is transmitted via a portion of a broadcast or cable signal. This term may have a modifier that further defines it. For example, broadcast teletext generally refers to electronic text transmitted via the vertical blanking interval of an over-the-air television signal. Cable teletext refers to one-way transmission of electronic text via a portion of a cable signal. SCA teletext refers to one-way transmission of electronic text via a portion of an FM radio signal.
Videotex	Interactive electronic text transmitted via telephone line or a two-way cable system.
Downloading	The transmission of electronic text or computer software into a terminal, e.g. a personal computer, where it is stored and available for use after the transmission ends.

Other terms will be defined when they are used for the first time in the report.

2.1 Strengths and Weaknesses of Alternative Transmission Systems

An assessment of the strengths and weaknesses associated with alternative transmission systems for electronic text can become quite complex. It is useful to begin with a general "ballpark" description of system characteristics, as provided below. Sections 3,4 and 5 of this report will develop the analysis further and discuss many specific advantages or disadvantages of transmission alternatives in relation to real world services.

Broadcast teletext. Broadcast teletext via the vertical blanking interval (VBI) of a television signal has a relatively small capacity: 75-150 pages or "frames". This capacity may increase in the late 1980s when older model TV sets are no longer in use and additional VBI lines become available. However, broadcast teletext will remain a service for relatively low volume content.

In addition, teletext is inherently a one-way system: users can only receive information. On the positive side, teletext is likely to become a relatively inexpensive service for users. If manufacturers build decoders in large quantities, as expected, the add-on cost of a teletext component to a TV set will probably fall below $ 150 (early decoders will cost more). The low cost of teletext may in turn lead to a rapid penetration of U.S. households.

There are reasons to be concerned about teletext access by those involved with higher education. That is, higher education must compete with other services for the limited number of frames that can be transmitted. Further, there are questions about

teletext reception problems. Manufacturers claim that the chief gremlin - short-term ghosting - will be overcome by an automatic adaptive equalizer that is to be built into teletext decoders.

Cable teletext. The principal difference between broadcast teletext and cable teletext is system capacity. In cable, an entire channel may be used for teletext transmission. This increases the number of frames or pages in a teletext service to approximately 4,000. However, it must be noted that only forty percent of American homes subscribe to cable, whereas 98% receive broadcast signals. Further, many older cable systems have 12 channels or fewer, and are not likely to devote an entire channel to a teletext service.

Videotex (via telephone). A videotex service that uses the telephone network for transmission has a number of advantages. It may be fully interactive; system capacity is not limited by the transmission environment; and telephone lines are installed in nearly every home and school. Further, access to the telephone network is guaranteed under existing law, and the system is quite robust from an engineering perspective. One significant problem in telephone-based videotex is cost. Each user incurs normal telephone charges plus access fees in relation to use of the computer-stored information. Unlike teletext, where 1-10 million users can simultaneously share the over-the-air signal, each videotex user individually accesses a "port" in the computer and places demands on the processing power of the system. This means that in addition to cost, there are limits on the number of people who can simultaneously use a videotex service. Hence,

videotex must deal with "traffic" issues, e.g. how many people can be accommodated at a given time, and, at what times of day will the greatest numbers of users call the service?

Videotex (cable). A videotex service that uses an interactive cable television system for transmission shares many characteristics with telephone-based videotex. There are two important differences however. First, cable-based videotex should be cheaper for users. A second difference relates to the "upstream" capacity of interactive cable. In order to understand this, an analogy may be helpful. Relatively speaking, an interactive cable system has a gigantic pipeline going into each home and a thin rod leading out of the home. The thin rod carries information back "upstream" to the cable system's host computer. If the return signal is a simple choice of options, as in Warner Amex's QUBE system, virtually everyone can use the service simultaneously. However, if the return information is more complex, e.g. a paragraph typed by a user, then system capacity, service design and network traffic become important issues. In a higher education context this means that cable videotex is more suitable for applications that do not overburden the upstream capacity. For example, it is more suitable for a multiple choice quiz than a test in which students must type an essay and send it upstream to the host computer.

Diskettes and cassettes for personal computers. Electronic text may be stored on small diskettes or audio cassettes for use in personal computers. A major strength of this means of distribution is that it bypasses transmission questions entirely: the diskettes or cassettes may be purchased in a software store

or sent through the mail. They have a modest capacity per diskette or cassette. However, an educational package might involve several diskettes. This form of distribution is more akin to traditional publishing in that material is prepared months in advance, manufactured and physically distributed. For these reasons, the material cannot be timely in the sense of news, nor is it readily updatable. Further, this system of distribution is dependent on the penetration of personal computers into homes and schools.

Downloading. Strictly speaking, the downloading of electronic text is not an additional means of distribution. Rather, it is a method that complements the alternatives described above. Downloading involves the transmission of electronic text frames and computer software via broadcast, cable or telephone into a terminal that can store the frames or software for use when needed. It is suggested as a way to effectively increase the capacity of a system like broadcast teletext and/or reduce the cost of telephone-based videotex. It should be noted that downloading is in an early stage of development and there may be technological barriers to its widespread implementation. Further, it requires a decoder or terminal with sufficient memory to store frames. Additional costs are associated with this storage capacity.

3. APPLICATIONS OF ELECTRONIC TEXT IN EDUCATION

This section provides a review of electronic text trials and services that have provided educational content. These are divided into three geographic groups: Britain, Canada, and the U.S. Major research findings from the trials and services are aggregated under appropriate topics e.g. graphics and design, following the general review of projects.

3.1 The British Experience[1]

The bulk of educational applications in the U.K. have been initiated by the British Council for Educational Technology (CET). CET has set up an umbrella group within Britain's Prestel videotex service and encouraged schools and libraries to participate as information providers and users. More than 100 schools (principally at a high school level) and libraries have participated. Library applications have been guided by the Association of Special Libraries and Information Bureau. In general, educational groups have been among the largest users of Prestel. Champness (10, p. 14) reports that education ranks 4th or 5th on a regular basis in the Prestel League Table of Users. Among the broad range of applications have been:

- Supplementary course materials in economics, business, geography and social studies.
- Guidance materials and information about the status of individual applications to British universities.

1. This section draws from Champness (10), Wheeler (49) and Kerr (personal communication).

- Computed assisted learning packages. Hatfield Polytechnic's Advisory Unit For Computer Based Education has put 12 CAL packages on Prestel.
- Abbreviated college course catalogues. This was an element in the Glasgow High School Project sponsored by the Scottish Council for Educational Technology.
- Downloaded software and information in support of Open University courses. This project was developed by the Educational Technology Department of Open University.
- Language learning.
- Public Prestel terminals in libraries.

The reactions to Prestel in education may be characterized as positive with qualifications. It has received positive marks by educators for ease of use; effectiveness in conveying brief supplementary materials; and motivational value in stimulating student interest in topics. In addition, CET has developed a "Starter Kit" for schools and has encouraged new applications. However, Prestel is criticized as too expensive and overly commercial in orientation. Further, much concern has been expressed about teacher resistance to videotex and the need to provide better teacher training in uses for Prestel. A recent trend in Prestel has been downloaded telesoftware to reduce costs for users.

There have been relatively fewer uses of broadcast teletext for education in the U.K. The "19 Schools Project" provided teletext pages in support of educational TV programs such as "Exploring Science". Teletext pages were made available before and after the program, providing information for both teachers and

2. Reported by Richard Hooper, former Director of Prestel, in a speech at New York University, April 7, 1983.

students. In addition, the hearing-impaired community in the U.K. has utilized teletext for a variety of educational and consumer information services as well as to provide captioning. Sweden has also made extensive use of captioning for supplementary services to the hearing-impaired and language training for immigrants (32).

More recently in the U.K., attention has turned to the downloading of educational software via teletext. A trial began in Spring 1983, with an evaluation by Brighton Polytechnic.

3.2 The Canadian Experience[3]

In Canada, the government's Department of Communication (DOC) has a mandate to promote educational and social uses of Telidon. Telidon is the Canadian electronic text standard. It may be transmitted via cable, broadcast television or the telephone network. Since education in Canada is governed largely by policies at a Provincial level, the Department of Communication has established a special advisory panel on education with broad representation from the Provinces. This advisory panel has played a major role in shaping Canadian applications of electronic text in education.

The largest group of educational projects in electronic text has been conducted by the Ontario Educational Communication Authority (OECA). They have conducted trials in broadcast teletext, cable teletext, and telephone-based videotex. In addition, they have participated in a large commercial trial of videotex, Vista,

3. This section draws from Bowers (2), Cioni (13), and OECA (33).

operated by Bell Canada. OECA's broadcast teletext and cable teletext service, EDUTEL, is a 100-150 frame magazine with a strong emphasis on educational services. It contains short quizzes about history, math puzzles and supplementary materials in support of educational programming. In addition, it contains course descriptions, educational news and lists of jobs for students. Many of these services have been developed jointly with community colleges that receive the TV Ontario signal. OECA's videotex service offers a 10,000 frame database on career guidance for students and information for guidance counselors.

Bell Canada's Vista trial was begun in 1981 and now serves several hundred users. It provides several large educational databases, e.g. Encyclopedia Britannica, Statistics Canada, Readers Digest, TV Ontario database, and World Book information services.

In addition, more than a dozen Canadian universities, community colleges and vocational training schools are conducting Telidon trials. Most of these have received funding support from the Canadian government. A few of the applications are outlined below.

- The University of Victoria is using Telidon to support computer aided learning courses in physics and language arts.
- The University of Calgary offers a telecourse (Teaching Grammar in an Integrated Language Arts Program) via audio teleconferencing with Telidon text and graphics.
- The University of Western Ontario has integrated Telidon into a journalism course. Students create 25-30 stories per day. These are carried by the Grassroots Telidon trial in London, Ontario.

- The Alberta Correspondence School, in association with the Alberta Telephone Company and the Alberta Educational Communications Authority offers a stand-alone correspondence course on The Mechanics of Machines via Telidon videotex.

A large body of research on educational applications of electronic text has emerged from Canadian trials and services. These findings are described in Section 3.4

3.3 The U.S. Experience

There has been a good deal of activity in the U.S. related to electronic text and education. Most of the applications have been directed towards the educational needs of the general public; educational services for special groups, e.g. the hearing impaired; and electronic text for a K-12 group. Public broadcasting stations have assumed a leading role in testing these services, as well as non-educational applications of electronic text. Indeed, 18 PTV stations have provided some form of electronic text service.

It is useful to begin this review with two public television stations that have developed electronic text trials specifically for higher education.

KPBS and KUON TV. KPBS TV and the Center for Communications at San Diego State University have developed and tested electronic text materials to supplement an educational PTV series, "Understanding Your Investments". The trial utilized INDAX, an interactive cable system developed by Cox Cable. After viewing each television program in the 12 part series, students in the San Diego test homes accessed the INDAX system for additional instruction and information. The project received a systematic evaluation in

order to assess perceived learning and attractiveness of the service. In addition, they tested a variety of educational formats for electronic text, e.g. class notes, timely updatable information, reference materials, self quizzes, viewer feedback, and instructional games. Generally, they found INDAX useful for educators and attractive for students. However, the project group suggests that their efforts represent the first steps in developing maximum uses of software capabilities and exploiting the full educational potential for the system. This has led to a follow-up second phase, described below.

KUON TV and the Division of Continuing Studies at the University of Nebraska-Lincoln developed three stand-alone courses (with more than 4,000 frames) using the Cox INDAX system: Comparative Modern Governments; Business Writing; and Marriage and Family. The project explored the interactive capabilities of INDAX, with particular emphasis on role playing, simulations, and educational games. One of their major goals was to explore how interactive instructional components could strengthen existing print-based courses.

In addition to these instructional objectives, the KUON project explored several important organizational and technological issues associated with electronic text. For example, they developed a group structure for designing electronic text telecourses. The group structure enables faculty, instructional designers/programmers and independent study specialists to work as a close team in creating lessons. Further, KUON has tackled two technological

issues that have important implications for future services: a/ frame creation at a distance from the host computer; and b/ transencoding of frames from a high resolution alpha-geometric system to a lower resolution alphamosaic system.

In a follow-up to these activities, KPBS and KJON along with WHA and WGBH formed an electronic text consortium to explore a range of educational services delivered in electronic text form. The Electronic Text Consortium was funded by the Annenberg/CPB Project and began operations in 1984. This report is the first publication of the Consortium.

WETA TV. WETA TV in Washington, D.C. and the Alternate Media Center at New York University began a trial of broadcast teletext, using Canada's Telidon technology, in the Summer of 1981. The trial included 40 homes and 10 public sites (one university, one high school and two libraries were among the sites). The research phase concluded in the Summer of 1982 and a follow-up test phase concluded in Fall 1983. WETA teletext provided a broad range of information, including news, weather, games and events in Washington as well as educational information. Educational frames have been directed towards pre-teens, students at Gallaudet College, and citizens who use the D.C. public libraries. Many of these groups have served as information providers to the service.

The WETA teletext service/research directed particular attention to high quality graphics and the role they play in conveying information. In addition, WETA developed stand-alone presentations of teletext that are independent from the broadcast

signal. This application, using a Hempton unit developed in Canada, permits Telidon text and graphics to be stored on an audio cassette, fed into a playback terminal, and accessed in a classroom or other presentation situation.

WGBH TV. WGBH TV began its exploration of electronic text in 1971 when the WGBH Caption Center was founded. The Caption Center has become a national resource, providing Line 21 captioning services for the hearing impaired. More recently, the Center has provided captioning for the CBS teletext service. In addition to providing service, the Caption Center has conducted extensive research on the use of electronic text to meet special education needs. Among the outcomes of this research has been a multi-level captioning system that adapts electronic text to the reading levels of a given audience.

In August 1982, WGBH began an eleven month teletext trial using the French system: Antiope. The trialwas aimed primarily at high school students and secondarily at university students, library users and the general public. The 100 frame teletext service, called SCOOP, contain news, weather and special interest stories for students. SCOOP emphasized timely information that has relevance to its target audiences as well as frames that are integrated with the high school curricula. In addition, SCOOP has provided students with an opportunity to write for teletext.

WHA TV. WHA TV and the University of Wisconsin-Extension have played a major role in developing text channels that are integrated within the Line 21 captioning system. That is, in

addition to displaying captions the Line 21 decoders can receive up to two channels of text information. The WHA TV service, Infotext, provides agricultural market information, weather forecasts and UWExtension bulletins from agriculture and agribusiness specialists, as well as the Associated Press Newscable Wire and news from the Wisconsin Office for the Hearing Impaired.

There are two channels of electronic text in the WHA TV service. Channel 1 consists of three "magazines" for agricultural groups. Channel 2 provides news, captioned program schedules, and public service bulletins. In addition to transmitting the services on Line 21 of their broadcast signal, WHA provides Infotext as a telephone-based videotex service. The use of personal computers as a terminal for videotex has become a major thrust in their research and development efforts.

WHA TV's electronic text activities are noteworthy for the extensive organizational work that has accompanied the development of services. They have built an information provider network and tested several alternative promotion campaigns to help market the service.

KCET TV. KCET TV began a teletext magazine service in Spring 1981, following two years of technical evaluations and planning. Initially, the service was offered to selected public sites, including eight schools, and later to test homes in the Los Angeles area. KCET's teletext trial has employed Antiope technology. Further, they have worked closely with local CBS and NBC affiliates in assessing public reactions to teletext.

KCET's teletext trial has offered two services. NOW is

an electronic news magazine of approximately 70 frames. It provides news, weather and entertainment information for the general public. KCET's educational service has focused on the provision of instructional materials that are not typically available in the classroom, with a target audience of 4th-6th graders. Their educational teletext magazine includes POPSICLE, 10 frames of fun material for kids, and THINK SHOP, a 60 frame section with interactive instructional exercises for use in school. They have provided features on computers, the history of education, famous explorers, space exploration and California history. The trial also contained an evaluation component (21). It revealed very positive reactions to the service. In particular, teachers pointed to the catalytic function of teletext: it prompted classroom discussion and served to motivate students as well as convey information.

Other PTV Electronic Text Services. In addition to the stations described above, at least 11 other PTV stations are providing some form of electronic text service. Those listed below are using Line 21 text channels to transmit agricultural information, local and national news, and in a few instances, entertainment and educational information. Many of the stations carry a national Line 21 text feed provided by PBS and the U.S. Department of Agriculture. Others use a national newswire feed or create the text service locally. And recently, KCET began a commercial text service, using Line 21, to provide information at public locations such as shopping malls.

KBIN	Des Moine, Iowa
KFME	Fargo, North Dakota
KMTF	Fresno, California
KOZK	Springfield, Missouri
KUFT	Gainesville, Florida
KWCM	Appleton, Wisconsin
WEDU	Tampa, Florida
WILL	Urbana, Illinois
WNET	New York, New York
WOUB	Athens, Ohio
WTTW	Chicago, Illinois

Public Sector Videotex Trials. Two public sector videotex trials in the U.S. have relevance to an assessment of electronic text and higher education: Green Thumb and Channel 2000.

Channel 2000 was a three month, telephone-based videotex trial conducted by the Ohio College Library Consortium in association with a commercial group, Banc One. One hundred homes participated in the trial. Channel 2000 provided a 32,000 page encyclopedia, the card catalogue of a large library, and general educational information, as well as commercial services (e.g. home banking). The Channel 2000 evaluators reported a very enthusiastic response to the service. This differs from the findings of others who found very large educational databases to be moderately attractive for consumers. However, the findings may indicate that such a service is viable if it is directed towards a target group with an interest in such information, as was the case in the Channel 2000 trial.

Green Thumb was a videotex trial jointly conducted by the U.S. Department of Agriculture, the Kentucky Cooperative Extension Service, and the University of Kentucky. The operational period of the trial ran from March 1980 to July 1981. Approximately 200

farmers in two rural Kentucky counties received the service. Videotex information included detailed weather analysis, commodity prices, home economics, 4-H/Youth information, and community development information. The project received a rigorous evaluation by the University of Kentucky and the Stanford Institute for Communication Research.

The Green Thumb project demonstrated that a local videotex service can work (even though they experienced many technical problems) and further, that many citizens state a willingness to pay for information: most users said they would pay $ 8.75 per month for the service they experienced during the trial, or $ 17.50 per month for an expanded service. However, Green Thumb did not test the broad consumer marketplace. Most of the farmers were upscale and the information had direct relevance to their business. Nonetheless, Green Thumb was an important step forward. The evaluators learned a great deal about service design and system configuration, e.g. they argue that teletext would have been a more appropriate delivery method for this application. Further, the project team stressed that it is quite difficult to organize a large network of local information providers. In this sense, Green Thumb was an organizational innovation as well as a technological one.

Open Channel Text Services. Many groups have begun to offer a text service on normal cable channels. These "open channel" text services transmit the information just like regular television programs. Therefore, there is no need for a special decoder in homes or schools. At the same time, users cannot select pages.

They must watch passively as the frames scroll before them in a linear fashion.

WUFT and the University of Florida Electronic Text Center have provided two open channel services on a local cable system in Gainesville: Gainesville Cable Press; and UF Night Owl. Gainesville Cable Press provides 45 frames of news information in a 15 minute cycle. UF Night Owl was replaced recently by "Graffiti World", a service with poetry, prose and bulletin board information for students. Both services are integrated within an academic program that trains students in electronic journalism.

The Alternate Media Center has provided an open channel text service, Apple Bytes, on Manhattan Cable for two years. The service is created by NYU students and Alternate Media Center staff. Information is provided by several community groups and local schools. Content includes community event listings, promotional messages for nonprofit groups, poetry and drawings by NYC grade school students, and consumer information.

San Francisco State University has experimented with a hybrid system that combines open channel text and telephone access to a large database. A large body of educational materials have been created by San Francisco State's ITV Center. A person accesses the material by calling the host computer via touch-tone telephone and, using the touch-tone keys, requesting specific frames of information. The information is displayed on an open channel of the local cable system. While this is a fascinating experiment,

it is not practical as a regular service, since an entire cable channel must be assigned to each user.

Electronic Text Messaging. While much attention has been directed towards electronic text as a medium for providing information, it is important to note that many videotex systems can be used for the exchange of messages between individuals. And indeed, message transmission has been very popular in those services that have offered it. Moreover, a large number of videotex message systems have emerged spontaneously. The New York Times estimates that more than 500 electronic bulletin boards are operating in the U.S., with more than 20,000 regular users. In its most basic form, an electronic bulletin board consists of a personal computer with a modem and a special software package that allows the personal computer to receive, store, and send messages to other personal computers over telephone lines. Most electronic bulletin boards are run by individuals and organized around a topic, e.g. computers, cars, literature, bible study, and how to win at video games. Individuals learn about these bulletin boards from friends or notices in computer magazines. They call a bulletin board devoted to a topic of interest to them, read messages left by others, and enter new messages.

3.4 Research Findings

Research associated with the trials and services described above may be grouped under a few categories: effectiveness; attractiveness and acceptability; usage patterns and characteristics of users; and side effects/benefits/disbenefits. Generally, the

findings are positive. At the same time, they indicate that there are many problems to be overcome and much to be learned.

It has been demonstrated in several trials that electronic text can be an effective educational tool (10,12,22,33,43). However, Champness (10) argues that effectiveness has been defined too narrowly as an A-B comparison between electronic text and face to face teaching environments. There is much work ahead in developing new uses for electronic text as well as enhancing other materials (e.g. telecourses) through electronic text and thereby improving the effectiveness of existing educational products. The KPBS and KUON trials have begun to explore these new areas.

Further, there is much to be learned about the nuances of effectiveness in relation to electronic text. For example, Trueman (43) reports that average students using Telidon-based math lessons did not fare as well as a comparable group in a face to face setting. However, advanced students using the Telidon lessons fared better than their counterparts in a face to face learning environment. Several trials reported that student motivation appears to be one, important intervening variable that may influence the effectiveness of electronic text in an educational setting.

Attractiveness and acceptability are complex issues as well. A body of data from a few studies (18,22,34,39) suggests that equipment problems, slow access time, poor page design, complex indexing structures, and the absence of attention to human factors'

issues in the design of keypads and terminals reduce attractiveness and acceptability. However, there is disagreement on a number of other issues. For example, one set of researchers has presented evidence that high quality graphics increase attractiveness (11, 28,33). Other groups associated with alphamosaic systems have argued that limited graphics did not hurt the attractiveness of the service (21,39).

Clearly, teacher resistance has been an issue in many trials and services. Some argue (12,21,31) that strong promotional efforts and special attention to teacher training can overcome this resistance under most circumstances. The Canadians, in particular, have devoted a great deal of attention to user committees and training support as a way of overcoming potential resistance.

The KPBS research points out the complexity of these issues. Comparisons between INDAX and Non-INDAX users (Non-INDAX participants viewed the video programming without electronic text enhancements) showed that INDAX participants tended to rate the information higher on "interest" and "informative" scores but lower on "usefulness" scores. There is also suggestive evidence that the attractiveness of INDAX electronic text may have reduced the attractiveness of the video programming.

Early users of electronic text in homes have tended to be economically upscale, professionals, heavy users of other new technologies, and heavy consumers of information generally (19, 23,34). However, these user characteristics must be viewed

cautiously, since the trials or services were often targeted towards these groups. In one study of public setting teletext, Blacks and Whites, blue collar and white collar, upper middle and lower middle income groups used the service equally (7). There are inconsistent reports that males have used these services to a somewhat greater degree than females (7,19,23).

In home settings, electronic text has been used in relatively brief sessions, typically 10-20 minutes (18,23). However, some uses have encouraged longer viewing sessions of 20-40 minutes (21 and unpublished reports from the Field Enterprises Night Owl service in Chicago). In classroom settings, preferences have been expressed for individual viewing and small group viewing of electronic text in relatively brief sessions (under 30 minutes) (21,33). The location of terminals or decoders has also been important in school settings - restricted access to terminals or complex scheduling has discouraged use.

A number of studies have attempted to assess preferences for educational services within the context of general consumer information preferences. No consistent pattern has emerged. Education is rarely the first or second choice of consumers, but it is mentioned consistently as a desirable component in an electronic text service. Typically, education falls in the second or third quartile of preferred information services. Rather than attempt to isolate a popularity ranking for education in an electronic text service, it may be more useful to describe a few characteristics of information that received high marks

from users. Four characteristics are noteworthy: local, timely, targetted/specific, and manageable volume. To some degree, these characteristics overlap. That is, users appear to be saying that they want information that is "relevant...to me...right now... in the task I am facing...and in a form that I can use". In educational settings, it has been important for electronic text services to meet existing needs; fit into existing curricula; enhance or supplement other materials, not duplicate them; and be easy to use.

In a few early critiques of electronic text, concern was expressed that teletext or videotex might produce a disbenefit, i.e. reduce student interest in print materials and create even greater dependence on the television environment. To the contrary, early evaluations of trials and services suggest that electronic text increases or supports users' general desires for information and helps to motivate greater interest in reading print materials (23,31).

Lessons From Computer Assisted Instruction. It is useful to note that electronic text in support of higher education is not an entirely new phenomenon. A well established form of electronic text, computer assisted instruction, has a history of more than fifteen years in educational settings. Further, CAI has received rigorous and extensive evaluations. Some of the findings from these earlier evaluations may help us to make better use of teletext and videotex in higher education.

Jamison et al (26) in a major review of a few hundred studies that compared CAI with classroom instruction notes that CAI has

been proven effective. At the same time, CAI has been less than a triumphant success in higher education - for reasons other than effectiveness. Hooper (24), drawing upon a five year national program of development and research in the U.K., outlines many of the problems associated with computer assisted instruction and offers some solutions that are relevant to electronic text. First, he argues that much of CAI has been limited to drill and practice. Further, too much emphasis was placed on crude CAI imitations of classroom instruction rather than the explorations of new ways to utilize the medium. In addition, many CAI lessons have been very rigid and do not allow the student to actively manipulate the computer. Hooper argues as well that many CAI lessons reduced complex and rich areas of knowledge to simplistic and mundane rules or explanations. He cites four helpful paradigms that emerged from Britain's National Development Programme in Computer Assisted Learning. These can inform early planning in electronic text, but they are most useful in directing attention to the need for basic learning models in a new medium.

- Instructional Paradigm. This paradigm includes drill and practice, or the transmission and reception/retention of text messages. The instructional paradigm assumes that a conventional body of knowledge exists. Under these circumstances the computer can serve as a "patient tutor".

- Revelatory Paradigm. This paradigm emphasizes simulations. Key ideas are "more or less" revealed to a learner in the course of exercises. When well designed, the student feels he/she is discovering knowledge in a rich and fascinating educational environment. When poorly designed, this approach can render education a mysterious and impenetrable black box.

- Conjectural Paradigm. This is appropriate for modeling and computer science applications. It emphasizes "what if" situations and the manipulation of ideas. The student tries to develop metaphors and models within a problem oriented theory of knowledge.

- Emancipatory Paradigm. Here, the computer does calculations, graph plotting, and processes information for the student. This paradigm treats the computer as a device to save labor and time.

Perhaps the most important lesson from the CAI experiences is to avoid rigid models and refrain from imposing technology on education where it is not appropriate. A new medium requires considerable creative development and careful testing in order to match its strengths with real educational needs.

Research Findings and Practical Lessons About Graphics and Design. There is a large body of research findings on electronic text graphics as well as a good deal of accumulated knowledge from day to day field operations (1,11,22,28,30). A few generalizations can be extracted from this body of material.

- High quality graphics are valued by users who are exposed to them.

- Appropriate use of color, layout and font are often as important or more important than the presence of a gaphic in producing attractive pages.

- Graphics are not a substitute for words, but they are quite valuable in creating a "conceptual base" to facilitate learning. High resolution graphics function well in maps, models, caricatures and iconic illustrations. They are not appropriate in situations that call for photographic realism (28). For example, in a biology lesson, graphics are useful in illustrating the body parts of a grasshopper. However, high resolution alphageometric graphics are not suitable for showing subtle variations in the color and texture of a frog's skin.

- In low resolution alphamosaic systems, abstract graphics often work better. However, they require greater interpretation by a viewer. This approach therefore may be more appropriate in higher education settings than in services for pre-teens.

- "Decorative" graphics that do not convey useful information are less preferred than an uncluttered text-only screen (22,30).

Organizational and System Lessons. Some of the most valuable lessons that have emerged from educational trials and services of electronic text are related to the practical issues of system configuration, data transmission, and staff organization.

The first lesson emerging from nearly every trial is straightforward: it takes longer to implement a service than the group planned. This relates in part to problems in obtaining equipment and testing it. Equally important, electronic text services require a trained and well coordinated staff, and this requires time to develop. KUON TV in Nebraska and OECA in Canada, among others, have developed specific methods to train and coordinate production staff for electronic text.

A second important issue relates to management of the data stream. In simple terms, an electronic text frame is a packet of data. An individual frame may contain 160 bytes or 1600 bytes. The efficiency with which frames are created as well as the amount and type of content affect the number of bytes per frame. From a user's perspective, a service with inefficient management of the data stream is slower than one that is efficient. A few variables interact in this situation: the skill of a frame designer in using efficient methods to create frames; software

assistance available in some systems which can "optimize" the data stream; repetition of popular frames in a transmission cycle to effectively reduce access time; and shutting down sections of a database at those hours of the day when traffic on the system is heaviest. The problems associated with data stream management as well as the solutions to those problems vary among the electronic text systems and the means of transmission. However, it is an important issue in all services and one that requires a new set of management skills.

Electronic text technology is undergoing rapid change. This creates some problems for a system operator. For example, OECA reports that as their software was changed and updated, it was difficult to edit older frames created with the earlier software. Similarly, decoders in homes and schools are currently undergoing a "generation" change every 1-2 years. Thus, in the U.K., the BBC faces a dilemma of whether to provide special frames that only the latest generation decoder can use. At some point, de facto standards are likely to emerge. Until then, a university or PTV operator of electronic text systems will face a difficult "balancing act" in serving different generations of equipment.

System Costs. In one sense, questions about electronic text system costs are akin to asking, "How much does it cost to run a newspaper?" or "How long is a piece of string?" There is extraordinary variability in system costs. Nonetheless, it is helpful to provide a few ballpark estimates.

Few groups in higher education or public broadcasting stations are likely to develop and build a very large videotex service

such as Prestel, though they might become an information provider to such a service. Prestel is reported to have cost over 200 million dollars for development and implementation. Below, four alternative levels of electronic text participation are described in terms of equipment costs.

1. CBS estimates that it will cost $ 2500 in equipment for an existing full service TV station to insert their national CBS teletext signal into the local transmission. The CBS estimates for original text creation capability at a station range from $ 40K to 150K, depending upon the volume of pages to be created.

2. A group that seeks to create text frames for a large videotex service operated by someone else, e.g. Viewtron, may wish to purchase an American Bell Frame Creation Terminal with a modem and, in all likelihood, a separate decoder and monitor. This equipment will cost approximately $ 40K. However, a Canadian firm recently introduced a software package that enables a group to use an IBM personal computer and graphics tablet for videotex frame creation. The software package costs approximately $ 6K. Thus, a group could become an information provider to a large videotex service for approximately $ 10K (i.e. $ 4K for the IBM personal computer and $ 6K for the software package).

3. A group wishing to create an open channel text service for a local cable system can do so with the following equipment:

   For Page Creation

Apple II Plus (48K)	$ 1,200
Disc Drive and Controller Card	550
Color Monitor	450
Apple Graphics Tablet	675

   For Storage

Corvus 5 Megabyte Drive	3,250
Constellation Multiplexer	900
Interconnect Cable	600
	$ 7,625

   (Source: Alternate Media Center, New York University)

4. A university or PTV station that seeks to establish a major electronic text center for teaching purposes as well as the creation of text frames for teletext, videotex and cable will likely require a minicomputer, 3-4 frame creation terminals, 5-10 personal computers with frame creation capability, frame insertion equipment, as well as several monitors, modems, printers and graphics tablets. Such a text center will likely cost $ 250-350K for equipment. Software leasing fees and staff costs are not included in this estimate.

4. COMMERCIAL APPLICATIONS AND EXPERIENCES

This section reviews selected commercial experiences with electronic text from two perspectives. First, what inferences can be drawn from commercial trials and applications to date for the development of electronic text services in higher education? Second, how is the commercial market developing? The latter issue is important for those higher education applications that will make use of or piggyback on the developing commercial market.

Table 1 below outlines selected commercial applications of electronic text. The table emphasizes U.S. trials and services, but does list some European applications for comparative purposes. Home banking trials and services are not included.

TABLE 1.

Selected Commercial Trials And Services
January 1984

NAME	LOCATION	TYPE	SUBS/USERS (BUS. & CONSUMERS)
United Kingdom			
Prestel	National	Videotex	40,000
ORACLE	National	Teletext	1,400,000
France			
Electronic Directory	National	Videotex	150,000
Canada			
VISTA	Toronto & Montreal	Videotex	500
IRIS	National	Teletext	500
Grassroots	National	Videotex	1,800
Teleguide	Ontario	Videotex Kiosks	500

TABLE 1.
(Cont.)

NAME	LOCATION	TYPE	SUBS/USERS (BUS. & CONSUMERS)
Sweden			
Text-TV	National	Teletext	225,000
United States			
The Source	National	Videotex	40,000
CompuServe	National	Videotex	70,000
Dow Jones	National	Videotex	120,000
NY Times/Mead Data	National	Videotex	6,000
Gateway	California	Videotex	*
CBS-IBM-SEARS	NA	Videotex	**
Viewtron	Florida	Videotex	NA
CBS Extravision	National	Teletext	+
NBC Teletext	National	Teletext	+
KIRO TV	Seatle	Teletext	20
WKRC	Cincinnati	Teletext	300
Keycom	National	Cable Teletext	NA
Keycom	Chicago	Videotex	*

NA Number of subscribers or users is not available

* Service to be launched during 1984.

** Service announced but no date set for launch

\+ Service is broadcast but only a limited number of decoders will be available during 1984.

4.1 Commercial Services in the United Kingdom

British experiences with the Prestel videotex service may contain some lessons for U.S. higher education services. British Telecom conceived of Prestel as a mass information utility for consumers. They relied, initially, on a special terminal dedicated for Prestel use only and employed a complex billing system. Further, they put aside interactive services and concentrated on one-way delivery of information from a very large database. In hindsight, each of these decisions appears to have been a mistake. After four years of marketing the service, Prestel had fewer than 40,000 subscribers. Of these, approximately 3,000 are consumers.

In 1984, several changes have been introduced. These reveal a new direction for Prestel. First, they have introduced software (cost: 50 pounds) that adapts personal computers and renders them Prestel terminals. Second, they are introducing many interactive services, e.g. home banking, shopping and electronic mail. Third, British Telecom has introduced flat rate fees for consumer use of Prestel, e.g. a 50 pound flat fee for unlimited use on weekends and during evening hours (this is a yearly fee). Equally important, Prestel has begun an experimental service in which owners of personal computers can access software programs. These are downloaded from the Prestel host computer into a user's personal computer with Prestel adaptor.

In addition, the British have begun to reconfigure Prestel as a "gateway" service. Previously, all information was stored in the Prestel mainframe computers. In some of the new services, Prestel functions as a link or gateway for the consumer to another

computer where the desired information or service is stored.

While Prestel floundered in its first few years, British teletext has been an extraordinary success. Over one million households now receive CEEFAX (on the two BBC channels) and ORACLE (on the two commercial channels) teletext services. However, it would be unwise to infer from the British experience that U.S. videotex cannot succeed and U.S. teletext cannot fail. The market research findings, discussed in Section 4.4 are much more complex.

4.2 Commercial Services in Canada

Nearly all commercial services in Canada are still in a trial phase. Thus, there are few marketplace lessons to be inferred. It may be noted that Canadian planning in 1979-81 focused overwhelmingly on telephone-based videotex. Further, the Canadian strategy emphasized a high resolution system: Telidon. Since then, planning efforts and market trials have begun to explore a broader range of transmission options. Also, the Telidon standard has been modified to accommodate the Presentation Level Protocol (PLP) "standard" proposed by AT&T. Presentation Level Protocol can provide a range of text and graphics images, from high resolution alphageometrics to low resolution alphamosaics. An inference may be drawn that the Canadians are adopting a more flexible attitude towards transmission and levels of service. In addition, it should be noted that three or four Canadian groups have begun trials with videotex kiosks - freestanding units, often in shopping malls, where large numbers of people can access frames.

This approach is similar to U.S. applications by WETA, WGBH, and KCET. It may represent an important intermediate step in the development of electronic text services, much as the corner drugstore introduced millions of citizens to telephone service in the first half of the 20th century.

4.3 Commercial Services in the U.S.

A number of commercial databases have been available in the U.S. for several years, e.g. The NY Times/Mead Data Information Service, Lexis, Nexis, and Lockheed. However, these are aimed at business users predominantly. Further, they are quite expensive, typically $ 75-150 per hour of use.

Three videotex services have been marketed to general audiences since 1979: The Source, CompuServe, and Dow Jones News Retrieval. Their combined subscriber base in early 1984 was approximately 230,000. Of these, fewer than 30% are estimated to be consumers. The services charge $ 4-8 per hour for evening and weekend use, and $ 20-30 per hour for weekday use during business hours. It is generally accepted among industry analysts that the Dow Jones service, emphasizing stock quotes and business news, may develop into a viable business. The Source and CompuServe, emphasizing general information and games, are not viewed as favorably. Significantly, all three of these groups are developing spinoff cable teletext and cable videotex services in which users will be charged a flat monthly rate.

Recent videotex trials in the U.S., notably Times Mirror in California, CBS/AT&T in Ridgewood, New Jersey, and the first

phase AT&T/Knight Ridder trial in Florida emphasized interactive services along with information. In 1984, three new videotex services have begun or are scheduled to begin: Viewtron in Southern Florida; Keycom in Chicago; and Gateway in California. In addition, CBS, IBM and Sears have stated that they will develop a service but no date has been set for the launch. Along with the development of new services there has been a shift towards the use of personal computers as terminals for receiving videotex and cheaper, flat rate charges for services.

Two major trials involving electronic text on cable were completed in 1983: Time Inc.'s cable teletext trial (Timetext) in San Diego and Orlando; and Cox's cable videotex trial (INDAX) in San Diego. Time Inc. has stated that it has no plans to launch a service, while Cox has stated that it will launch a service in 1985. A national cable teletext service, Keyfax, began transmission in 1983 but the major introduction of the service will take place in 1984.

National teletext services were begun by CBS and NBC in Spring 1983. Both are advertiser supported and therefore free to consumers who make a one-time purchase of a decoder. There is considerable uncertainty however about the availability of decoders. A few decoders are available in early 1984 (eg Panasonic and Sony), but it is unlikely that large numbers of decoders will be offered to the public before 1985. In addition to NBC and CBS commercial teletext services, a number of groups e.g. PBS and Merrill Lynch are planning commercial data services delivered via broadcast teletext. Yet another class of service involves open channel electronic text information. More than 60 newspapers

provide some form of open channel, scrolling text service on local cable systems. These services are supported by classified ads in most instances. The majority of open channel text services use simple character generator equipment and contain no graphics. In Spring 1983 however, two newspapers - NewsDay (Long Island, New York) and the Providence Journal (Rhode Island) began open channel services using high resolution Telidon systems.

A few inferences can be drawn from these commercial U.S. activities in electronic text. First, no single means of transmission dominates the market. Further, a range of text and graphics standards are being tested. There is a general consensus that terminals and decoders must be inexpensive. Related to this has been a growing interest in personal computers as potential terminals for the services. Industry groups appear to believe that small, one-way information services must be advertiser supported, whereas cable teletext and cable videotex services can probably charge $ 5-10 per month for service. The pricing structures reveal further that industry groups believe a market exists for videotex @ $ 25 per month, if interactive services are provided along with information.

4.4 Research Findings in Commercial Trials

A good deal of the research associated with commercial trials and services is proprietary and not publicly available. Nonetheless, a surprisingly large body of data has been published. Much of it has relevance to an assessment of potential applications for electronic text in higher education.

By and large, commercial research findings support the education research described earlier in Section 3.4 Consumers

like electronic text services but they are not willing to pay a great deal of money for them. There is a consistency in the most desired information services: news, weather, sports, business information, entertainment/games and TV guides (e.g. Viewtron, British teletext, Velizy trial, and CBS teletext). Education has not been among the most desired services, but it has achieved moderate to good desirability and use scores. A manufacturers survey of British teletext users found that 30% of homes viewed educational content regularly. Times Mirror reports that 50% of trial homes felt education content is essential in a videotex service. Viewtron reported a high demand for videotex frames that helped students prepare for college entrance exams.

Six percent of accesses to content frames in the French Velizy trial were for education frames. However, since only 5% of the content was educational, the education sections received a high rate of accesses/content available. CBS reports that 20% of accesses to frames in its Los Angeles teletext trial were for general educational content, e.g. health information and information for children.

In nearly every trial and service where electronic messaging has been offered as a service, it proves to be popular (Times Mirror, Viewtron, Velizy and The Source). Further, local information and timely updating of frames have characterized much popular content.

In the commercial trials and services, as in the educational trials, user households have been upper income predominantly;

heavy users of other media; heavy consumers of information generally; and somewhat younger than the general population. As in the case of educational trials discussed earlier, many of the commercial trials pre-selected the users or sought them out through marketing campaigns. Therefore, it is important to exercise caution in generalizing about the attractiveness of services for segments of the population.

Reports about length of viewing session have been confounded by novelty effects, i.e. many of the trials have been for three months or shorter.[4] If one "discounts" some of the very short trials, it appears that teletext sessions average 10-15 minutes, while videotex sessions average 15-30 minutes. The number of viewing sessions per week varies a good deal in both teletext and videotex trials, from every other day to twice a day. It is worth noting as well a general trend reported by Telenet and Tymnet in accesses to databases and commercial videotex services, i.e. the number of calls by a typical user to a database has been increasing but the length of calls has been decreasing. Since these users are businesses predominantly, it is not clear whether a similar pattern will emerge in longterm classroom and household uses of electronic text.

Generally, household use of teletext and videotex has been heavier in the evening than daytime. A few trials have reported

4. Those who have studied the novelty effect in electronic text trials report that usage tends to stabilize after 3-6 weeks (CBS and Alternate Media Center). However, others have found a longer and slower decay in usage (Stanford Institute for Communication Research, in the Green Thumb trial). In the latter case, it is unclear whether the phenomenon being recorded is a novelty effect or a more serious drop in interest.

peaks of use near 6 pm. Many groups have examined "switching" behavior - do users switch into teletext during regular TV program viewing or at commercial breaks? While some of this behavior has been observed (18,23), it appears that a greater percentage view teletext just before or just after an evening session of TV programming. Moreover, Times Mirror among others report little or no impact on time spent with other media by new users of electronic text.

4.5 Technology Penetration in Households

One component in most efforts to plan commercial applications for electronic text in the decade ahead is an assessment of the likely penetration for technologies in U.S. households. This exercise is important for higher education as well since many educational services will require various types of equipment in homes. Table 2 below employs a conservative method for projecting growth, developed by Roger Hough. This method examines the rate of growth for a new technology thus far; compares this with earlier technologies that grew at the same rate; and projects continued growth in a pattern similar to the earlier technology.[5] This method cannot be used to estimate the growth of teletext or the new interactive videotex services since they do not yet have a sales record in the U.S. However, it provides one way to estimate the growth of a few technologies that may affect the development of electronic text.

5. The methodology and analysis are treated more fully in John Carey and Mitchell Moss, A Review of New Telecommunication Technologies and Public Broadcasting. Washington, D.C.: Corporation for Public Broadcasting, 1984.

TABLE 2

Projected Growth For New Technologies in Households

(Percent Penetration US Households)

	1982	1985	1990
Basic Cable	31.5	45.3	50.7
Pay Cable	17.1	23.8	32.7
Interactive Cable	.02	3.0	9.7
Video Cassette Units	5.1	16.3	26.1
Personal Computers	2.6	14.1	25.3

Sources for 1982 Figures: Goldman Sachs, Paul Kagan Assoc., Burnham and Lambert, NY Times, Electronic Industry Assoc.

Base for U.S. Households: 1982, 83 million; 1985, 89 million; 1990, 98 million.

These projections suggest that by the end of the 1980s, broadcast television and the telephone network will still lead other transmission systems by providing near universal service to U.S. households. However, basic cable may be in half of U.S. homes and interactive cable TV in ten percent of homes. Nearly one third of households may be paying explicitly for video content (pay cable), while just over twenty percent may have a means of storing video programs with recorded electronic text (video cassette recorder owners). Equally promising is the potential of the personal computer to serve as a terminal for receiving and storing electronic text frames. This potential is explored further in Section 4.6 below.

4.6 Characteristics of the Personal Computer Market

The importance of the personal computer in the development of electronic text services for higher education relates, first, to the potential for personal computers to serve as terminals/decoders. Software cards are available, or will be available in the second half of 1984, to permit Apple and IBM personal computers to receive NAPLPS videotex. Similarly, software is available that permits Apple and Atari personal computers to access Prestel. In addition, personal computers can store electronic text and receive downloaded videotex. Moreover, some high-end personal computers (e.g. IBM) can be adapted to serve as frame creation terminals.

Second, the personal computer market appears to be growing at a remarkable rate. The penetration of personal computers in households is difficult to estimate since many are used for a business at home rather than general family use.[6] Table 2 indicated that 2.6 percent of U.S. households owned a personal computer at the end of 1982. This figure rose to 8 percent in the first half of 1984. It appears further that the amount of families with access to a personal computer (i.e. including shared business and family use) is over 10 percent (NY Times estimate).

A number of recent surveys provide additional data about the personal computer market. A Rand survey indicated that 11

6. An IBM survey of those purchasing an IBM personal computer found that 60 percent of sales were to homes. However, the computer is used predominantly by a business at home.

percent of homes with a teenager stated that they owned a personal computer. Further, the Roper organization in a national survey found that half of U.S. households expressed an interest in buying a personal computer 'at some point'. This is supported by a study of those connected with a university, in which 51 percent indicated an interest in buying a personal computer during the next five years (Case,12). Collectively, these data suggest that a strong personal computer market is developing and that a large percentage of the public will have access to a terminal in their home or a public building such as a library or school.

An examination of survey data on the uses for personal computers[7] and the reasons for purchase, indicates a moderate to strong receptivity for educational applications. It appears that individuals purchase a personal computer most often because their 'kids will need it' or 'to become computer literate', or, based on a general sense that they will discover useful applications after buying it (Gallup). The uses to which a personal computer is put depend in part on the level or price of the computer; the presence of youngsters in the home; and the presence of a business at home. In general, the more inexpensive a computer the more it is used for games. Conversely, personal computers costing more than $ 2,000 are used overwhelmingly for business applications. The education market is strongest in homes with computers costing $ 250 - 2,000. Table 3 indicates stated usage in a general survey of personal computer owners.

7. This discussion draws on survey data published by Gallup, The Roper Organization, Future Computing Corp., and Yankelovich, Skelly and White.

TABLE 3

Major Uses For Personal Computers

Use	Percent of Respondents Indicating Some Usage (Multiple Answers Possible)
Games	51
Business or Office Homework	46
Child's Learning Tool	46
Adult Learning Tool	42
Home Finance/Budgets	37
Business in Home Use	27
Word Processing	18
Mailing Lists	16
Information Retrieval	14
Appointment Calendar	9
Storing Recipes	9
Calorie Counting	4

Source: Gallup Survey 1983

These survey findings and market growth data suggest that some applications of electronic text may be able to draw upon the personal computer as a terminal (e.g. for videotex) and appeal to the "content appetites" now being developed. At the same time it should be noted that reviews of educational software for the personal computer market by Teachers College (Columbia University) and the Bank Street College of Education as well as a survey of higher education users (8) have been highly critical of the quality of much software. Educational electronic text will be

challenged to create high quality materials that surpass the existing norm in personal computer software. A need for much content development work is clearly indicated.

5. AN ASSESSMENT OF OPPORTUNITIES AND BARRIERS

In conducting an assessment of opportunities and barriers for electronic text in higher education, it is helpful to examine some characteristics of the existing environment for audio-visual materials and telecommunication services. While electronic text may forge new educational applications and change the higher education environment over time, it is reasonable to assume that many early uses for electronic text will fit into existing patterns or supplement them.

The existing educational context for AV and telecommunications is very difficult to capture. Below, a few tables are extracted from one of the few comprehensive analyses available (15). These are supplemented by additional data from a variety of sources.

5.1 The Existing AV and Telecommunications Environment: Selected Characteristics

At least three characteristics of the existing AV environment are important to note: how are materials currently distributed by two-year colleges, four-year public colleges, and four-year private colleges; for what uses; and, what social, economic and educational values may be inferred from these patterns of use? Table 4 outlines the primary distribution channels for television materials.

TABLE 4

Primary Distribution Outlets For TV Materials

TYPE OF OUTLET	ALL COLLEGES (N=1824)	2-YEAR COLLEGES	4-YR PUBLIC COLLEGES	4-YR PRIVATE COLLEGES
Public Television	22%	26%	25%	15%
Commercial TV	7	10	6	5
Cable Systems	9	11	12	5
Campus Closed-Circuit	42	40	41	45
Other*	20	13	16	30

Source: CPB/NCES Higher Education Utilization Study 1981

* Other includes VCR, ITFS, Satellites, and Teleconferencing

The heavy use of campus closed-circuit television is important, particularly since this means of distribution has received little testing thus far in electronic text trials. It is clear as well that public television stations represent a critical distribution outlet. Cable distribution is relatively low in Table 4. However, the use of cable is growing. A survey by Statistical Research Inc.[8] in 1982 revealed that 20 percent of U.S. colleges used local cable in the delivery of services, and 26 percent planned to use it in 1983. CPB's Higher Education Utilization Study also revealed (1979 data) a large increase in the number of colleges that planned to use television for instruction in the future. These trends indicate a growing potential market for electronic text materials that are

8. Statistical Research Inc., Audio Visual Market Study. Washington, D.C.: PBS Video and Corporation for Public Broadcasting, 1982.

incorporated within an instructional television environment. At the same time, a distinction must be drawn between four-year private colleges and four-year public colleges or two-year colleges. Four-year private colleges have been more reluctant to use television in providing services. In CPB's Higher Education Utilization Study 37 percent of four-year private colleges reported no use of TV at all, compared to 8 percent and 28 percent of public four-year and two-year colleges who reported no use. However, four-year private colleges have taken a lead in using personal computers for education (e.g. Drexel, Carnegie Mellon, Stevens and M.I.T. among others require or expect all entering freshmen to have a personal computer). A link between the personal computer and instructional television - through electronic text - may appeal to private colleges and serve to increase their overall receptivity to instructional television. This is a curious strategy in which an older medium, instructional television, might piggyback on the acceptance of a new medium.

It should also be noted that four-year private colleges tend to use television for non-instructional purposes or as an instructional supplement, with less use of TV to offer courses. This has implications for early applications of electronic text. It would appear that four-year private colleges may be more receptive to freestanding electronic text for campus information, registration assistance, library catalogue materials, as well as electronic text to supplement programming that is used within

courses. These patterns are apparent in Table 5 below, which outlines the uses of television by type of college.

TABLE 5

Specific Uses of Television By Type of College

Percentage of Respondents Reporting Usage
(Multiple Responses Permitted)

USE	TOTAL (2993)	2-Year (1154)	4-YR PUBLIC (453)	4-YR PRIVATE (1386)
On-Campus Instruction	79%	80%	87%	75%
Off-Campus Instruction	34	45	46	17
Counseling	44	39	60	41
Outreach	38	41	58	25
Promotion/ Recruitment	41	50	50	27
Staff Development	31	36	38	23
Other	21	14	28	24

Source: CPB/NCES Higher Education Utilization Study 1981

Table 5 indicates private colleges are not the only group to rely heavily on television for on-campus instruction and non-instructional services. This pattern of use is supported by SRI's survey in which responses indicated that 66% of all AV purchases by colleges were for educational materials that enhance or supplement courses and serve non-instructional needs. To the degree that electronic text addresses existing needs and fits into existing patterns of use, it will be important to

provide a full range of services.

A few additional characteristics of the existing higher education environment for television and AV materials may reveal important underlying values of the colleges involved. First, a large proportion (it is difficult to extract a specific percentage from the CPB/NCES data) of instructional materials used by colleges have involved the local college in some aspect of the production. Electronic text is very well suited to local production or co-production in which the end user (the college) creates some of the material. Second, the assignment of credit to on-campus instructional materials is very important, and almost as important for off-campus instructional materials: 85 percent of on-campus instructional TV and 79 percent of off-campus instructional TV were for credit, in the CPB/NCES survey.[9] This suggests that instructional applications of electronic text should pay heed to all factors which might affect their status as "for credit" AV materials.

In a very pragmatic sense, colleges are developing a keen awareness of the "marketplace" and competition with other colleges for students and status. The SRI survey reveals this quite clearly. A college's involvement in telecourses is related, in part, to marketing issues. The three most frequently cited reasons by colleges for using a telecourse were: reaching students who are far away; reaching new and non-traditional students; and being

9. This represents a secondary analysis of the data in Table 4, p 9, CPB/NCES Higher Education Utilization Study.

the first to offer such a program.[10]

These characteristics of the existing environment for television and AV materials in higher education may be summarized:

- Cable, public television, and on-campus closed-circuit television are likely to be used heavily for distribution of materials in the decade ahead.
- Four-year private colleges represent a somewhat different user group compared to four-year public colleges and two-year colleges.
- For some applications, it is important for the local college to be involved in part or all of the production.
- Telecourses represent one important instructional application, but the universe of instructional services is much broader. Materials to be used within courses, supplements to educational programming and freestanding instructional services as well as non-instructional materials have vital, existing roles in higher education.
- Colleges assess the "marketplace" value of television materials as well as their instructional value.

5.2 Opportunities

The review of existing AV/TV applications in higher education (Section 5.1) suggests a broad range of opportunities for electronic text. These include but are not limited to:

- Supplements to telecourses.
- Supplements to educational and general television programming that can render them more useful in a higher education context.
- Electronic text modules that can be used within face to face course environments.

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10. Statistical Research Inc., op cit, pp 111-114.

- Stand-alone electronic text courses.
- Electronic text to provide non-instructional services, e.g. campus health information, library bibliographic information, and course registration assistance.

Opportunities in these areas will be related, in part, to the distribution system available to or regularly used by a college; penetration of necessary equipment on-campus or in homes served by a college; costs of providing the service and the potential for cost recovery; and a demonstration to professors and students alike that electronic text can bring excellence to instructional and non-instructional services.

The existing distribution system is quite complex. It does not favor one form of electronic text over another, except in a specific locale. This implies that producers will need to create alternative forms of electronic text for distribution to colleges that use cable videotex to reach students at home or closed-circuit teletext for on-campus students. Penetration of equipment is complex as well, but there is some evidence that personal computers will serve an important role as terminals in homes and schools. Other terminal equipment is not likely to be distributed equally in homes and classrooms. For example, the SRI survey revealed that 90 percent of colleges possess one or more VCRs, whereas just over 10 percent of homes possess a VCR. Nearly all colleges and homes can receive broadcast television signals, but it is not clear how the penetration of teletext decoders will grow. This uncertainty reinforces the need for

electronic text producers to be flexible and create alternative forms of a product to accommodate the equipment available in a given home or campus.

There is very little evidence to date that points to greater opportunities for electronic text in specific subject areas, e.g. math versus history. Electronic text appears to be suitable for a wide range of subject areas. However, there is some evidence that electronic text is very appropriate for:

- Relatively small instructional units per viewing session (it is not suitable for reading the full text of a novel).
- Timely information and information that needs to be updated periodically.
- Caricatures, models, line drawings and graphic symbols, but not information that requires photographic realism.
- Local information and information that requires local adaptation (e.g. a lesson in which each instructor adds material to render the lesson more suitable for a given group of students).
- Instructional information that enhances, extends, or adapts other material to specific higher education needs.
- Interactive simulations and instructional games.
- On-demand information that is not restricted by a class schedule or broadcast program schedule.

A few additional areas of direct and indirect opportunity may be noted. First, electronic text focuses inherently on reading. It can be used to improve reading skills. Further, when used in conjunction with telecourses, electronic text may help to overcome the perception that telecourses have contributed

to reading problems by diverting elements in the instructional process from print to voice and visual images. Also, electronic text systems are likely to promote an interest in computer science and help provide minimal computer literacy skills. These potential side benefits of electronic text may, in turn, be used to encourage utilization of the services.

Second, the relationship between electronic text and audio-based services deserves more exploration than it has received to date. For example, some forms of electronic text can be stored on audio cassette. In this form, electronic text can accompany audio cassette-based correspondence courses. In addition, the same technology that has led to the digital encoding of text can be used to encode audio materials - the British call this "Heardata". This means that in the next few years teletext services may have an audio component. More immediately, information stored in audio form can be accessed via touch-tone telephone. The IRS Teletax service provides a simple example. With Teletax, a person calls a central number, listens for a special tone, then touch-tones the number of a tape he/she wants to hear. In a more advanced version of this service, Hoffman-LaRoche drug company allows doctors to use a touch-tone telephone in searching through an audio database that is structured much like a videotex service.

Third, the industrial "shape" of the electronic text market is unclear. Aspects of this report have implied that the market will take the shape of television, cable or telephone services. However, a large component of the market may be shaped by the publishing industry, e.g. electronic text modules may be

transmitted via cable and sold on a subscription basis like a magazine, or packaged on diskettes and sold in bookstores. This implies that potential relationships with educational publishers should be explored as electronic text applications are developed, tested, and move into the higher education marketplace.

Finally, electronic text opportunities in higher education are not limited to community colleges and universities. American businesses and the military have extensive need for higher education materials. Moreover, these groups are well suited to use electronic text since they have already invested heavily in computer technology. In the past, many businesses have not found universities responsive to their education needs. As a consequence, they developed their own training services (42). It is not clear whether electronic text will help to forge better relationships, but opportunities do exist to create higher education services for businesses and the military.

5.3 Barriers

The first set of problems associated with electronic text is technical: reception problems, inadequate repair services, prototype equipment, and software that is not fully debugged. Such problems are common with nearly all technologies when they are first introduced. Solutions to the problems require time, e.g. as more decoders are built reliability increases. Also, as a large volume of equipment moves into the market, repair services follow. In the short term, greater attention is required

to technical issues. Further, early applications and field tests will necessitate more technical support and skills by the service provider than will be the case in a few years.

A second barrier to electronic text development, as well as instructional telecommunications generally, is cost recovery. How can a college charge users for services? In this regard, electronic text brings strong assets. On cable, the service may be incorporated into a pay tier or, in some systems, transmitted on a pay-per-view channel that bills customers for each use. Telephone-based videotex can establish an account number for a user. This, in turn, provides a method for billing. Further, teletext decoders can be "addressable". This means that a decoder must be turned-on by a special signal in order to receive the text frames. The system can screen out users who have not paid tuition or other fees associated with the programming. For these reasons, electronic text may become attractive supplements to telecourses and other programming that does not currently provide a method of cost recovery for the local college.

A third barrier to electronic text development is common to all instructional materials: teacher concerns that the material is inferior, threatens their job, and/or does not allow them to participate in tailoring the material to local student needs. There is no hard and fast solution to quality concerns - quality will relate to who produces the content. However, it is quite important that early applications meet

the highest quality standards in order to help build a receptive attitude among teaching professionals.

Electronic text does lend itself to local involvement by teachers. Such involvement can serve a dual purpose of permitting a teacher to tailor material to local student needs and reducing potential anxiety by teachers that electronic text might eliminate their job.

A fourth barrier is associated with the general decline in college budgets. Why should a college with a declining budget invest in a new service? Electronic text applications will be challenged to prove that they are cost effective. A few attributes of electronic text may help to deal with this barrier. That is, electronic text may be used to assist, in a cost effective way, with on-campus and off-campus registration, student information services and other non-instructional needs of colleges and students. If such applications can piggyback on equipment used for instruction as well, colleges may realize operational efficiencies that justify investment in the service. Similarly, electronic text may be used as a value-added service that extends the life of telecourses or renders them useful in new areas. Such applications can help to justify new expenditures by colleges.

Finally, colleges will undoubtedly look to students for their reactions to electronic text. If students are attracted to colleges that offer electronic text as part of their service delivery mix, other colleges are likely to follow and implement similar services.

6. CONCLUSION

There is little doubt that electronic text is a powerful new medium with important implications for those who serve the needs of higher education as well as the general public. However, the specific shape of the electronic text market and the timetable for widespread implementation of services are less clear. Moreover, the vital work of forging educational tools with the new technology has just begun. What does this mean for institutions of higher education and other groups who provide services to the education community? The pattern of development for electronic text that has been outlined in this report supports a few conclusions.

- Electronic text is an appropriate area for involvement by those groups that are charged with the development of new educational services, e.g. The Annenberg/CPB Project, U.S. Department of Education and educational foundations.
- There will likely be a wide diversity of electronic text services, and no single service or means of distribution is best suited to the needs of higher education.
- A national education market in which one college can employ cable videotex while another relies on broadcast teletext and a third uses yet another form of electronic text will require flexibility and coordination by those who produce electronic text content. There is a need to understand how such coordination and flexibility are best accomplished.
- A major asset of electronic text, in education, is to add value to, or extend the usefulness of other educational products. This asset is particularly relevant in a tight economic climate.

- There is a need for a long term commitment to electronic text in the service of higher education. The development of comprehensive national services will require several years.

- An emphasis should be placed on creative design of services and systematic evaluation of applications. This addresses a dual need of exploring how to achieve maximum effectiveness and utilization with this new medium, while at the same time rigorously assessing what it can accomplish and how it is received.

To some degree, the conclusions described above point to gaps in knowledge or areas where further work is required. A few additional information needs can be outlined. First, a good deal of practical knowledge can be extracted from early projects in relation to management of services, costs in creating frames, effective and ineffective promotional efforts, and ways to deal with technical problems. Second, there is a need to better understand the relationship between commercial and educational services which share a means of distribution, e.g. cable television, and how services can be integrated - where appropriate. In addition, there are a number of important public policy questions that require further investigation. For example, how can the privacy of system users be protected? Some European countries, notably Sweden (32), have developed comprehensive public policies.

Finally, this report has suggested that electronic text is an area of great opportunity and much uncertainty. These qualities strike at the heart of innovative projects in higher education: to explore opportunities, reduce uncertainties, and achieve a positive impact on education.

7. SELECTED BIBLIOGRAPHY

1. James Antes, Components of Pictorial Informativeness, Perceptual and Motor Skills, Vol. 47 (2), pp 459-464.

2. Peter Bowers, The Educational Community and Videotex Applications, Proceedings: Videotex 81. Middlesex: Online Inc. 1981.

3. Peter Bowers, Telidon and Education in Canada, Videotex, Viewdata, Teletext: Online Conference Transcript. London: Online Publications, 1980.

4. J.L. Campbell and M.B. Gurstein, Social Impact/Social Uses of Videotex in the Canadian Context, Proceedings: Videotex 81. Middlesex: Online Inc. 1981.

5. John Carey, Videotex: The Past as Prologue, Journal of Communication, Volume 32:2, pp 80-87.

6. John Carey, Ted Carpenter, Eileen Connell, Martin Elton, Martin Nisenholtz and Gary Schober, Teletext and Public Broadcasting. New York: Alternate Media Center 1980.

7. John Carey and Mark Siegeltuch, Teletext Usage in Public Places. New York: Alternate Media Center 1982.

8. Donald Case and Hugh Daley, Personal Computers: The New Academic Medium, Proceedings: 33rd Annual Conference of the International Communication Association. Dallas: ICA 1982.

9. Brian Champness, The Relative Merits of Speech Versus Text For The Output of a Variety of Communication Services: A Study of Relevant Literatures. New York: Alternate Media Center, 1981.

10. Brian Champness, Social Uses of Videotex and Teletext in the UK. Plymouth: Plymouth Polytechnic 1981.

11. Brian Champness and Marco Di Alberdi, Measuring Subjective Reactions to Teletext Page Design. New York: Alternate Media Center 1981.

12. Brian Champness and Ian Young, Social Limits on Educational Technology, European Journal of Education, September 1980.

13. Maria Cioni, Télidon and Education in Canada, Vista Directory and User Guide, May 1981.

14. Congressional Research Service, Information Technology in Education: Perspectives and Potentials. Washington, D.C.: U.S. House of Representatives, Committee on Science and Technology 1981.

15. Peter Dirr, Joan Katz and Ronald Pedone, Higher Education Utilization Study, Phase I: Final Report. Washington, D.C.: Corporation for Public Broadcasting and National Center for Educational Statistics, 1981.

16. David Dozier, Videotex Topic Preference Study. San Diego: Center for Communications, San Diego State University, 1983.

17. Martin Elton, Educational and other Two-Way Cable Television Services in the U.S., Human Aspects of Telecommunication. E. Witte (ed.), Berlin: Springer Verlag 1980.

18. Martin Elton and John Carey, Computerizing Information: Consumer Reactions to Teletext. Journal of Communication, Volume 33, Number 1, pp 162-173.

19. Martin Elton, Ric Irving and Mark Siegeltuch, The First Six Months of a Pilot Teletext Service: Interim Results on Utilizations and Attitudes. New York: Alternate Media Center, 1982.

20. A.D. Flowerdew, J.J. Thomas and C.M. Whitehead, Problems in Forecasting The Price and Demand For On-line Information Services. London: London School of Economics 1981.

21. Ronald J. Goldman, Elaine Gordon, Elaine Craig, and Richard Gingras, Teletext As An Educational Medium: The Los Angeles School Trial. Los Angeles: Community Television of Southern California 1982.

22. Kathleen Goodfriend, Nancy Bamberger, David Dozier and John Witherspoon, KPBS Interactive Videotex Project. San Diego: KPBS and San Diego State University, 1982.

23. William Herring, Descriptive Statistics of a Teletext User Survey in Plymouth England. New York: CSP Int. and New York University 1981.

24. Richard Hooper, National Development Programme in Computer Assisted Learning: Final Report of the Director. London: Council for Educational Technology 1977.

25. Ric Irving, Martin Elton and Mark Siegeltuch, The Last Five Months of a Pilot Teletext Service: Interim Results on Utilization and Attitudes. New York: Alternate Media Center 1982.

26. O. Jamison, P. Suppes and S. Wells, The Effectiveness of Alternative Instructional Media: A Survey, Review of Educational Research, 44:1.

27. Market Facts Inc., A Market Case Study of Telecourse Promotion. Washington, D.C.: Corporation for Public Broadcasting 1982.

28. Michael Mills, A Study of The Human Response To Pictorial Representations on Telidon. Ottawa: Canadian Department of Communications 1981.

29. National Commission on Libraries and Information Science, Public Sector/Private Sector Interaction in Providing Information Services. Washington, D.C.: U.S. Government Printing Office 1982.

30. Martin Nisenholtz, Designing For Teletext and Videotex, Computer Graphics World, Volume 5, Number 9, pp 49-54.

31. Office of Technology Assessment, Information and Its Impact on American Education. Washington, D.C.: U.S. Government Printing Office 1982.

32. Thomas Ohlin, Videotex And Teletext in Sweden - A Nation Decides. Stockholm: Commission on New Information Technology, Department of Education and Culture 1981.

33. Ontario Educational Communications Authority, Telidon and Education: TV Ontario/Department of Communications Field Trial For 1981-82. Toronto: OECA 1982.

34. William Paisley, Computerizing Information: Lessons of a Videotex Trial. Journal of Communication, Volume 33, Number 1, pp 153-162.

35. Michael Real, Videotex And Education: A Review of British Developments. San Diego: San Diego State University, Center For Communications 1981.

36. Patricia Renfroe and Kathleen Criner, How To Hire Staff For Electronic Publishing Ventures, Presstime, January 1982, pp 38-39.

37. Ronald Rice and Donald Case, Electronic Message Systems in the University: A Description of Use and Utility. Journal of Communication, Volume 33, Number 1, pp 131-152.

38. Ronald Rice and William Paisley, The Green Thumb Videotex Experiment: Evaluation and Policy Implications. Telecommunications Policy, 6 (3), 1982, pp 223-235.

39. Stuart Sutherland, Prestel And The User. Brighton: University of Sussex, Center For Research on Cognition and Perception, 1980.

40. John Syrett, Videotex: The Implications For Education, New Directions For Teaching and Learning: Expanding Learning Through New Communication Technologies, (No. 9). C. Knapper (ed.), San Francisco: Jossey-Bass, March 1982.

41. V. Thompson, Videotex in Education, Media In Education And Development, September 1982.

42. V. Thompson, Using Prestel in Educational Applications, Videotex - Key To The Information Revolution. Middlesex: Online Inc. 1982.

43. D. Trueman, Telidon and Computer Assisted Learning - A Report on the First Experiment Using Telidon For CAL, Videotex - Key To The Information Revolution. Middlesex: Online Inc. 1982.

44. Marc Tucker, The Turning Point: Telecommunications And Higher Education. Journal of Communication, Volume 33, Number 1, pp 118-130.

45. John Tydeman, H. Lipinski, R. Adler, M. Nyhan and L. Zwimpfer, Teletext and Videotex in the United States. New York: McGraw Hill 1982.

46. Christine Urban, Factors Influencing Media Consumption. Cambridge: Harvard University Program on Information Resources Policy, 1981.

47. Steven Vedro, Infotext: An Agricultural Electronic Text Service From WHA TV. Madison: University of Wisconsin-Extension 1982.

48. Paul Warner and F. Clearfield, An Evaluation of a Computer-Based Videotext Information Delivery System For Farmers: The Green Thumb Project. Lexington, Kentucky: Department of Sociology, University of Kentucky, 1981.

49. Martin Wheeler, Videotex in Language Training - Crossing International Lines, Videotex - Key To The Information Revolution. Middlesex: Online Inc. 1982.